Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/682
SWEDEN
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

Reactor Physics Studies and Comparison between Reactor Physics Data from Calculations and Mock-up Studies and from Measurements in the Ågesta Nuclear Power Plant

G. Apelqvist [1], P.E. Blomberg [2], O. Nylund [3], R. Persson [2]

At the time when the Ågesta reactor was designed, the only direct experimental information of relevant reactor physics data available was obtained from exponential measurements. The calculations were based on diffusion theory and four-factor formalism.

Complementary data has since been produced by new experimental facilities and calculational methods.

The 19-rod clusters were investigated in exponential and critical assemblies both in Sweden and at the Savannah River Laboratory in USA. The buckling was measured as a function of pitch, internal spacing in the cluster, and temperature. Void effects were also studied and intercell flux measurements made. The results of these measurements did not cause any appreciable change of the calculated neutron economy and hence of the design.

In the Ågesta reactor itself critical water levels were determined with three core sizes, with and without control rods. Bucklings and reflector savings were obtained from copper wire activations, and the reactivity loss due to temperature increase was measured up to 215°C with control rods in the core.

Microscopic properties in the lattice cell were investigated by means of activation techniques. The studies included determinations of neutron

1) State Power Board, Stockholm
2) AB Atomenergi, Stockholm and Studsvik
3) ASEA, Västerås

spectrum parameters, the initial conversion ratio, disadvantage factors and the flux peaking in the fuel pin connections.

The control rod worth and their influence on the power distribution have been calculated with homogeneous and heterogeneous methods. The extensive series of control rod measurements, both in critical and exponential assemblies and in the power reactor itself, served as a good base for correlation with the theory. The reactivity worths were obtained from measurements of bucklings and reactivity water-level coefficients, and from neutron pulse decay curves. The perturbation of the power distribution due to control rods was studied by activation techniques and movable detectors.

Dynamic characteristics are to be studied as a function of power level and burn-up by oscillatory perturbations and by noise analysis. Time constants and reactivity coefficients will be obtained by fitting an analogue model to the measured transfer functions.

A thorough preparation has been made for investigating the burn-up effects in the fuel elements, of which a representative set of pins have been inter-calibrated with the pile-oscillation technique. The changes of the excess reactivity and the neutron spectrum parameters in the fuel, as a function of the neutron dose, are to be included in the studies of the burn-up effect.